A PHAENOLOGICAL STUDY IN NEW ENGLAND

BY C. J. LYON

After reading a paper by Francis Darwin[1] in which he seemed to draw the general conclusion that the first flowering of plants in England did not correlate with the temperature factor, the writer undertook to determine the facts for this locality. He was fortunate in having access to complete records of reported first flowerings and to Weather Bureau records of temperatures. Even a cursory examination convinced him that the correlation was positive and generally striking.

At the Howe Library, in the village of Hanover, N. H., is kept a record and exhibit of the results of the competitive search for the early flowers. The writer attests to the real competition that exists and into which both young and old enter, so that it is fairly certain that the first blossoms are reported promptly, certainly more promptly than could be accomplished by any one person. The librarian, Miss Etta M. Clark, and her assistants have done the work of identification for years[2] and have used standard keys including Gray's Manual. The competitive interest serves as a check on the accuracy of the identification and the writer, in following the records for the spring and early summer of 1921, detected only a few minor inaccuracies. Miss Clark is to be given the credit for this part of the study and the writer takes this occasion to acknowledge her contribution to this paper.

In selecting species for the accompanying table, care has been used not to include: (1) those that did not appear in the records for at least three years out of the five; (2) those that could be easily confused, e. g. *Uvularia* and *Oakesia*, and certain violets; (3) those found only through July and August when the interest naturally lags and when certain collectors (including members of the faculty of Dartmouth College) have left the locality; and (4) specimens that were not collected in the immediate vicinity of Hanover.

The following table of temperature conditions for the years 1917–1921 inclusive, was drawn from the record books of the

[1] Darwin F. A Phaenological Study. New. Phyt. 18:287-298. 1919.

[2] The work was begun in 1914 but the records for the first three years are incomplete.

Weather Bureau's cooperating station at Dartmouth College. In each case the mean was obtained by averaging the maximum and minimum temperatures. The normal daily mean was obtained from the complete records of the years 1910–1920 inclusive.

Week or Month	Normal DailyMean Temp	Deviation from normal daily mean temperature				
		1917	1918	1919	1920	1921
January	17.3	+ .6	—9.35	+ .55	—4.	+ 3.65
February	18.7	—3.2	—3.5	+3.5	— .5	+ 4.85
March	30.1	— .4	— .9	+3.9	+ .9	+ 8.55
April 1–7	37.9	+ .7	+4.7	—1.6	—2.3	+11.
April 8–14	39.4	—6.7	+ .2	+7.7	—4.8	+ 5.9
April 15–21	42.9	+ .3	—1.4	+1.3	+ .7	+ 6.4
April 22–28	47.7	—4.1	—1.7	—4.3	—4.4	+ 5.2
April 29–May 5	49.7	—8.4	+2.9	+2.	—6.1	+ 4.1
May 6–12	53.2	—8.4	+7.2	—4.5	—5.1	— 2.8
May 13–19	54.6	—6.2	+8.3	— .8	—3.4	
May 20–26	57.9	—7.7	+5.1	+2.6	—1.	+ 2.8
May 27–June 2	58.9	—4.8	+6.6	+3.4	+6.4	+ 4.
June 3–9	60.5	+2.3	+ .5	+9.7	—2.1	— .8
June 10–16	62.0	+ .4	—3.8	+4.4	+2.9	+ .4
June 17–23	63.2	+2.2	—9.6	+3.4	—4.5	+ 2.4
June 24–30	65.8	—3.2	—3.	—2.4	+ .9	+ 4.
July 1–7	68.6	—2.9	—3.7	+4.6	—5.	+ 5.3

The chronological chart of the 104 species recorded is arranged in the order of the earliest dates recorded for the species for the years 1917–1921 inclusive. Practically it means that the order is that in which they appeared in the year 1921, which gave the earliest dates for all forms except those that appear with a star after the date following the name of the species. In a few of these cases it will be observed that no record appeared for the given flower in 1921.

The following interpretations as to the correlations with temperatures seem to be plainly indicated.

1917. In general the flowers were late in making their appearance and in the majority of cases were last of the five seasons (out of 91 recorded for 1917, 66 were last). Up through No. 17 there seems to be a tendency for the season to be a little

ahead of others, notably 1920. A glance at the temperature chart will show that there exists a strong correlation between the negative deviations and the late flowering. The season of 1917 is marked by a preponderance of negative deviations of comparatively large magnitude. The few positive deviations almost coincide with the periods of flowering in which the season was not completely behind all other seasons. Certainly the cool temperature seems to have been responsible for the late flowering.

1918 and *1919*—These two years can well be discussed together since on the chart their curves alternate for the second place to the earliest. Up through No. 22, 1919 (o) leads 1918 (‡) with a very few exceptions. At that point the flowering in April has passed. A study of the temperature deviations shows that the greater number of positives are on the side of 1919, especially during the months preceding flowering.

And with the coming of large positive deviations in the 1918 column for the month of May, if the temperature control is strong, the ‡ curve should lead the o curve through that month. With but four exceptions (nos. 27, 29, 30 and 40) it does lead through No. 72 where the flowering passes over into June, and indeed well on through the season with a few exceptions toward the end.

This last fact is true in spite of the winning of the temperature balance by 1919 from June 1st on. Either this is evidence against the importance of the temperature control, or, what seems more probable in the face of the other evidence, the start given through May to the 1918 plants was sufficient to keep most species well ahead for the rest of the season, when it had ceased to be a question of getting minimum warmth to grow and flower.

So the study of these two seasons seems to give evidence in favor of temperature control, particularly by that of the pre-flowering months, possibly by optimum conditions in mid-season that even carry over another month.

1920—This season (recorded by a †) is of little interest except as it partially confirms the results of 1917. With temperatures generally below normal from January on, it is not surprising to find that the curve generally falls behind all but 1917 (the coldest season), though there are glaring exceptions to that condition. The general lateness of the dates makes the writer feel that there is a distinct positive correlation.

1021—The correlation of temperature and flowering is obvious for this season. Sometimes the gap between the 1921 date and the nearest one to it is as great as three weeks as in the case of No. 21. This flower is not uncommon here and the discrepancy can not be attributed to chance.

Even in the case of a few species that flowered earlier in another year, in some cases at least that fact is correlated with a lowering of 1921 temperature. Nos. 55, 58, 59, 60, 67–72 can all be explained either by the absence of a 1921 record or by the fall of 1921 temperature to normal or below for the period May 6–19.

§ 1917 ‡ 1918 o 1919 † 1920 * 1921

Species	Earliest Date Mo. Day	MARCH 7	14	21	28	APRIL 7	14	21	28	MAY 7	14	21	28
1. Hepatica triloba	3–25				*	o†	§‡						
2. Tussilago Farfara	3–26				*		o	†	‡				
3. Epigaea repens	3–28				*	o	‡	†	§				
4. Houstonia caerulea	3–28				*			† o	‡	§			
5. Taraxacum officinale	4– 1					* ‡	o §	†					
6. Sanguinaria canadensis	4–10						* o	‡	§ †				
7. Viola rotundifolia	4–10						*o		§ † ‡				
8. Saxifraga virginiensis	4–10						*	o †	‡		§		
9. Claytonia virginica	4–10						*	o	§ † ‡				
10. Asarum canadense	4–10						*	o	§†	‡			
11. Antennaria sp?	4–10						*	o		†			
12. Dicentra cucullaria	4–10						*		§ ‡ †		o		
13. Fragaria virginiana	4–10						*		†o		§		
14. Caulophyllum thalictroides	4–10						*		§	‡ o †			
15. Erythronium americanum	4–12						*	o §	† ‡				
16. Dirca palustris	4–12						*		o †				
17. Dentaria diphylla	4–12						*			‡ o § †			
18. Capsella Bursa-pastoris	4–13						*		o‡		†		
19. Nepeta Hederacea	4–14						*		o ‡		†		§
20 Ranunculus abortivus	4–18							*	†		o §		

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Species	Earliest Date Mo. Day	APRIL 7	14	21	28	MAY 7	14	21	28	JUNE 7	14	21	28
21. Viola rostrata	4–18			*			o	‡	†	§			
22. Anemone quinquefolia	4–19			*			o†	§	‡				
23. Caltha palustris	4–21			*		‡	o	† §					
24. Viola blanda	4–22			*		‡†	o §						
25. Trillium erectum	4–25				*‡	†							
26. Arisaema triphyllum	4–25				*	‡	o † §						
27. Amelanchier canadensis	4–25				*		o ‡	†	§				
28. Aquilegia canadensis	4–25				*		‡ §	†o †					
29. Mitella diphylla	4–25				*		o	‡§					
30. Viburnum alnifolium	4–25				*			o‡	§				
31. Dicentra canadensis	4–26				* †		o ‡	§					
32. Viola pubescens	4–26				*		‡	†o§					
33. Waldsteinia fragaroides	4–26				*			† ‡	§ o				
34. Vaccinium pennsylvanicum	4–30				*			‡	†o §				
35. Tiarella cordifolia	5– 2					* ‡		o	† §				
36. Polygala paucifolia	5– 2					*	‡	o	† §				
37. Coptis trifolia	5– 2					*	‡	o	† §				
38. Zizia aurea	5– 2					*		† o		§			
39. Brassica nigra	5– 2					*		‡ o	†				
40. Saxifraga pennsylvanica	5– 2					*			o †	‡§			
41. Trillium undulatum	5– 4					*	‡† o						
42. Panax trifolium	5– 6					* ‡		† §					

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Species	Earliest Date Mo. Day	APRIL 7	14	21	28	MAY 7	14	21	28	JUNE 7	14	21	28
43. Maianthemum canadense	5- 6*					‡	*	§	o†				
44. Pedicularis canadensis	5- 7					*	†	o		§			
45. Corallorrhiza trifida	5- 7					*		o †			§		
46. Trientalis americana	5- 8					*	‡	o †§					
47. Clintonia borealis	5- 8					*	‡	o †		§			
48. Euphorbia Cyparissias	5- 8					*	‡o	†		§			
49. Aralia nudicaulis	5- 8					*	‡	o †			§		
50. Smilacina stellata	5- 8					*	‡ †			o		§	
51. Streptopus roseus	5- 8					*	†	o		§			
52. Rhodora canadense	5- 8					*		†		o ‡	§		
53. Cypripedium parviflorum	5-10					*	‡			o† §			
54. Orchis spectabilis	5-10					*	‡	o §					
55. Polygonatum commutatum	5-11*					‡	*	†					
56. Corydalis sempervivens	5-11					*	‡	†		o		§	
57. Erigeron pulchellus	5-12					*	‡	†o		§			
58. Viola canadensis	5-14*					‡§	†	o					
59. Cornus canadensis	5-15*					‡	*	†		o		§	
60. Ranunculus septentrionalis	5-16*					‡*	o †	§					
61. Potentilla canadensis	5-16					*‡	o			§			
62. Geum rivale	5-16					* o †						§	
63. Ranunculus acris	5-16					*	‡	o †					
64. Chelidonium majus	5-16					*	† o ‡			§			

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Species	Earliest Date Mo. Day	MAY 7	14	21	28	JUNE 7	14	21	28	JULY 7	14	21	28
65. Sisyrinchium augustifolium	5–16			*	† ‡	o	§						
66. Habenaria Hookeri	5–16			*	‡	† o	§						
67. Erigeron ramosus	5–20*			‡		†							
68. Erigeron annuus	5–20*			‡ *	o	§ †							
69. Trifolium pratense	5–22*			‡*		o †	§						
70. Carum Carvi	5–23*			‡*		† o	§						
71. Smilacina racemosa	5–23*			‡	o	† §							
72. Cypripedium acaule	5–23*			‡ o		† §							
73. Sarracenia purpurea	5–23			*		†o			§				
74. Arethusa bulbosa	5–23			*		‡†		§ o					
75. Geranium Robertianum	5–24			* o		‡ †							
76. Lychnis alba	5–24			* o		‡	† § o						
77. Linnaea borealis var. americana	5–24			*		o †	‡ §						
78. Medeola virginiana	5–26				* ‡	o†	§						
79. Oenothera pumila	5–26				*	‡ o †			§				
80. Nymphaea advena	5–27				*		†‡						
81. Trifolium agrarium	5–28*				o	‡ *	† §						
82. Chrysanthemum Leucanthemum	5–29*				‡	o†	§						
83. Hieracium aurantiacum	5–29*				‡	* o	§†						
84. Trifolium hybridum	5–29*				‡	o *	§						
85. Achillea Millefolium	5–30*				‡	* o †	§						
86. Iris versicolor	5–30				*	‡ o†	§						
87. Vaccinium Opulus var. americanum	5–30				*	o ‡ †			§				

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Species	Earliest Date Mo. Day	MAY 7	14	21	28	JUNE 7	14	21	28	JULY 7	14	21	28
88. Thalictrum polygamum	5–30				*	‡ † o			§				
89. Vicia americana	6– 3*					‡ o	*		§				
90. Prunella vulgaris	6– 4*					‡	*	o †	§				
91. Stellaria longifolia	6–6					* ‡ o			§				
92. Solanum nigrum	6–6					*	‡ o		§†				
93. Anemone cylindrica	6–10						* ‡ †	§					
94. Pentstemon hirsutus	6–10						*‡	o	†	§			
95. Apocynum androsaemifolium	6–13						* ‡	o †			§		
96. Rudbeckia hirta	6–13						* ‡ o		†	§			
97. Cypripedium hirsutum	6–13						*	o	§	‡	†		
98. Veronica americana	6–16*						o	*	§†				
99. Pyrola elliptica	6–16*						‡	o	*	§	†		
100. Asclepias syriaca	6–20						* ‡		o		§		
101. Mimulus ringens	6–20*						‡	*			o §		†
102. Spiraea salicifolia	6–23*							†*	o	‡	§		
103. Verbena hastata	6–24*							‡	*		o	§	
104. Hypericum perforatum	6–27								* o	‡	†	§	

Star by date indicates some other year than 1921.

In general the whole chart shows a wide range of variation for most of the species. Perhaps this is not unexpected for this rather severe climate but when the correlation between the recorded mean temperatures and the first flowering is as plainly shown as by the seasons 1917 and 1921, if not by others, it seems probable that temperature is the chief controlling factor.

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A CASE OF PISTILLODY AND STAMINODY IN THE PLUM.

BY HAROLD B. TUKEY

This past season in a variety of cultivated plum, probably (*Prunus triflora*) x (*P. triflora* x *Simonii*), a queer case of pistillody of the stamens and staminody of the petals occurred. These are not unusual phenomena but, as they are most often reported, one whorl of floral parts is entirely and uniformly replaced by another. In this case, however, there was more or less of a gradation from one member to another within the different whorls.

Normally the flowers of the plum (*Prunus spp.*) are arranged after this fashion: A single pistil, bearing one style and one stigma, at the bottom of a cup-shape receptacle on the edge of which are five sepals, five petals, and fifteen to many stamens-the petals alternate with the sepals. Fifty per cent of the flowers on the trees of this variety were so arranged, but the other fifty per cent presented a host of variability.

Frequently the stamens were replaced by pistils and when this was the case the pistils were either five in number and alternate with the petals or ten in number in five groups of two, likewise alternate with the petals. On the inner side of each of these pistils from the stigma to the base of the ovary ran a distinct suture, so that their appearance was that of what might be characterized as "introrse pistils," a name which is seen to be more appropriate when it is said that normally the pistils dehisced along this line and aborted the ovule contained within the ovary.